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User's Guide to INVEST V: A Computer Program for Economic Analysis of Forestry Investment Opportunities

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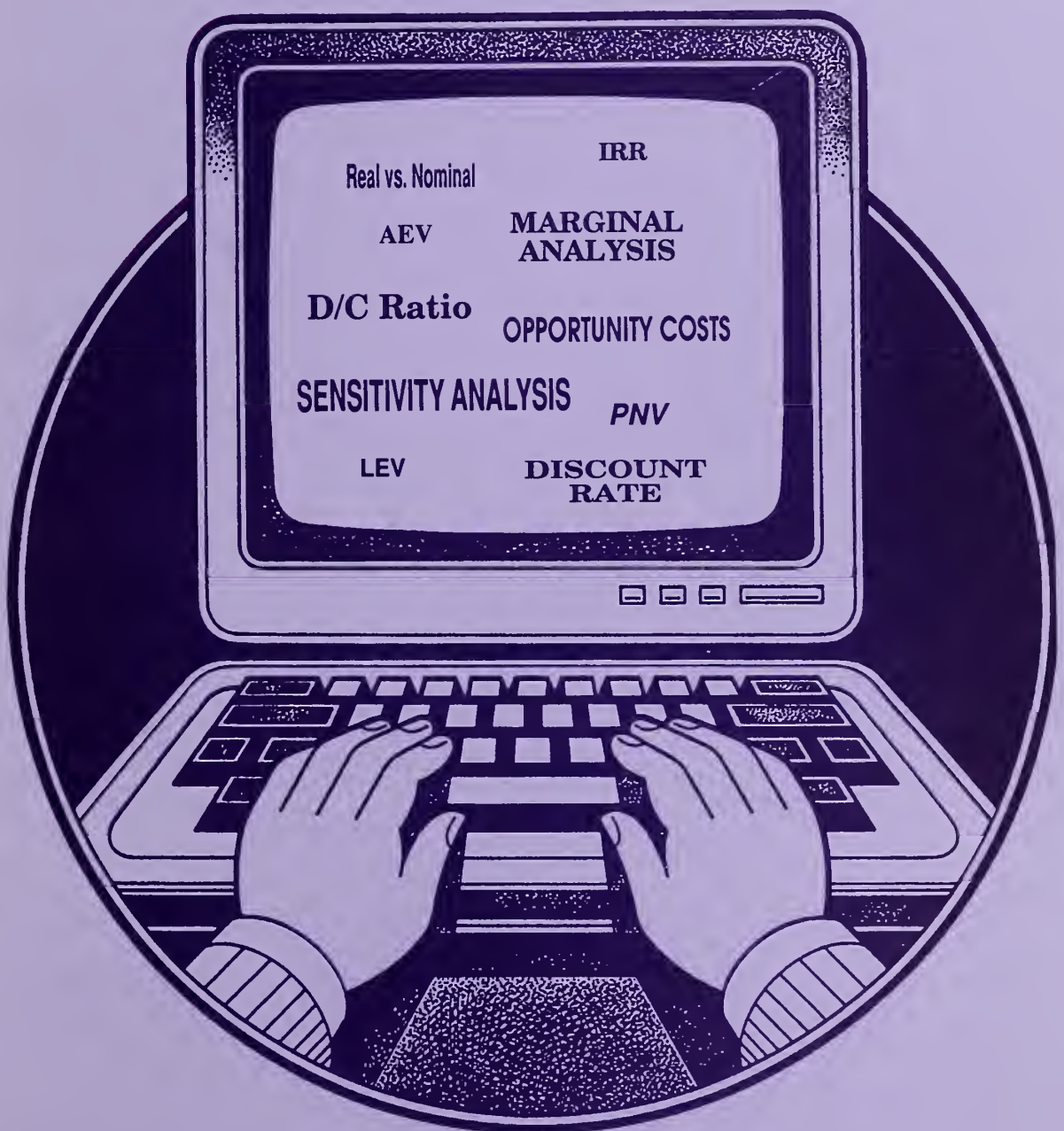

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Research Summary

Decisionmaking in forestry often involves analyzing forestry projects and programs as investment opportunities. INVEST V is a computer program to help users evaluate these opportunities; it operates on the Forest Service's Data General computer system and on any IBM-compatible microcomputer with 333 kilobytes (KB) of free random access memory (RAM). Data input is extremely flexible, including fixed- and free-formatted data files along with interactive data entry. The program accepts up to 100 base problems and alternatives, up to 990 cost and revenue items for any individual base problem or alternative, and up to a combined total of 990 items for all base problems and alternatives. Records can be associated with single payments, equal annual payments, and payments involving constant change. Discount rates of 4 and 7 percent are automatically provided; users specify up to three additional rates. Inflation and real value increase are provided for. Investment criteria include present net value, benefit-cost ratio, annual equivalent value, land expectation value, and internal rate of return. Other features include opportunity cost designation, sensitivity analysis, and marginal analysis. This guide presents an overview of INVEST V, explains data organization and program features, provides examples of data input and output, and discusses the program's limitations.

Acknowledgments

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Introduction

One of the most difficult aspects of decisionmaking in forestry is selecting a particular management opportunity or alternative. Alternatives typically share some common elements—they all involve allocating valuable economic resources for anticipated later production of valuable commodity outputs. These production processes are capital intensive, involving decisions that fundamentally increase the stock of capital over time. They are investment decisions.

Investment decisions in forestry can be relatively simple or highly complex. Simple decisions call for the manager to select from two or more management opportunities. Should a timber stand be thinned to a basal area of 80 or 200 square feet per acre? Should a manager invest in additional campsites or take these same dollars and construct a new interpretive facility? More complex choices may involve choosing a particular type of range or timber management. Complex program alternatives consist of unique aggregations of individual projects and management opportunities.

The basis for choosing among forestry projects or programs depends on the specific situation. Organizations differ; managers differ; decision contexts differ. Some decisions place environmental considerations first, while others emphasize physical output. But for a wide range of decisions, economic considerations are important, and economic efficiency analysis is appropriate. This type of analysis addresses the efficiency of resource use. Efficiency analysis is often called an investment analysis, because it assesses the relationship between the economic value of inputs and outputs over time.

INVEST V is a computer program designed to help assess the economic efficiency of forestry investment alternatives, whether they are projects or programs. INVEST V can be executed on either the Forest Service's Data General computer system or any IBM-compatible microcomputer with 333 kilobytes (KB) of free random access memory (RAM). The purpose of INVEST V is to provide a computer program that meets a wide variety of analysis needs, is simple to operate, and provides comprehensive output that is easy to understand. The main advantage of INVEST V over similar programs is input and output flexibility. Data input can be accomplished either through interactive data entry while executing INVEST V or by creating a data input file, in free or fixed format, external to INVEST V. Printed output includes several tables displaying data inputs, project rankings, and other desired project comparisons. Investment criteria include present net value, internal rate of return, benefit-cost ratio, land

expectation value, and annual equivalent value. The program can perform sensitivity analysis and account for inflation and real value increase. The interested user should consult any of several forestry texts that discuss the relative merits of the investment criteria, including Gunter and Haney (1984), Leuschner (1984), Gregory (1972), Davis (1966), and Duerr (1960).

Users are encouraged to read this guide before executing INVEST V. Users familiar with the principles of investment analysis and acquainted with computers can successfully execute the INVEST V program with little or no additional assistance.

Overview

INVEST V was developed from MTVEST (Zuuring and Schuster 1980), which had its roots in the Forest Service's INVEST III computer program (Dyrland and Gordon 1972), developed in 1972 and revised in 1974. MTVEST was originally intended to operate on the University of Montana's mainframe computer (then a DEC 20), before the Forest Service acquired its Data General computer system and microcomputers became widely available. INVEST V was developed to make MTVEST available to Forest Service analysts, whether they use Data General or microcomputers, and to update several MTVEST features. Consequently, INVEST V retains the same architecture and data entry options as MTVEST: a data input file is created (in advance or while INVEST V is being executed); the file is accessed and analyzed by program software; finally, a standard of output tables are developed. This data entry process is dated by contemporary standards (it does not use a relational database approach or a Windows environment). But data entry in INVEST V is straightforward, and existing data sets are easy to modify with a text editor. Unlike some contemporary computer programs, INVEST V does not require extensive or sophisticated computer skills. With INVEST V, the user is in control. The name change back to INVEST (rather than MTVEST) returns the name to its Forest Service antecedents. INVEST V will read and analyze MTVEST data files.

INVEST V performs economic analyses on a data input file that should fully describe the costs and benefits of a set of forestry investment opportunities, whether they are projects or programs. Economic dimensions of these opportunities are organized into "base problems" and "alternatives" to the base problem. A base problem consists of a series of data records necessary to describe an investment opportunity; associated alternatives consist of a series of modified base problem data records. Alternatives to a base problem are created by changing, adding to, or deleting data from the base problem. The data records for the base problem and alternatives form an ordered-series of entries that are read by INVEST V as a data input file.

Data records are classified into seven types, which must be placed in a specific sequence. As discussed in the Data Organization section, each type of record (termed a record type) contains unique data arranged in a specific order. The most frequently occurring data record is record-type 6 that contains data about a specific cost or benefit associated with a base problem or alternative. Other record types provide INVEST V with labels, discount rates, and special instructions. INVEST V can process up to 100 base problems and alternatives, up to 990 cost and revenue items for any

individual base problem or alternative, and up to a combined total of 990 items for all base problems and alternatives.

Once the user has decided how to organize forestry investment opportunities into base problems and alternatives and how to characterize each in terms of records, the data input file must be created. Input data sets can be provided to INVEST V by interactive data entry or through an existing data file (organized in a fixed or free format), as discussed in the Data Input and Output section. With interactive data entry, the user creates an input data file by responding to a series of questions posed by INVEST V. With an existing file, the user creates the input data file (using word processing, spreadsheet, or database software) before executing INVEST V.

INVEST V can perform a wide variety of economic analyses through a series of special program features. Some analyses are provided automatically while others are provided at the user's option. INVEST V will perform the following analyses on each project: discounted costs and revenues of project items at a user-specified discount rate and a summary project evaluation on the basis of benefit-cost (B/C) ratio, present net value (PNV), annual equivalent value (AEV), and land expectation value (LEV), each at five discount rates, together with project internal rate of return (IRR). Depending on a user's desire and the number of projects being evaluated, INVEST V can also provide sensitivity analysis (see Sensitivity Analysis), detailed item-by-item comparisons (see A and B Comparisons), analysis of opportunity costs (see Opportunity Costs), aggregation of similar cost and benefit items (see Combinations), comparison and ranking of all base problems and alternatives by eight investment criteria, and a marginal analysis summary. These features are discussed in the Program Features section.

Data Organization

Data input files for INVEST V can be developed in several ways. But the data must be organized exactly the same way for base problems and alternatives.

Base Problems and Alternatives

INVEST V minimizes the amount of data that must be specified or provided by eliminating duplicate input data. The principle underlying INVEST V is that of the base problem and alternatives. A base problem is a set of data that fully describes an investment situation in terms of value flow—amount, timing, and the type of cost or benefit. Here is how it works: enter all data needed to specify the base problem; data for alternatives are entered only when an alternative differs from the base problem. That is, INVEST V automatically assigns to an alternative all data in the base problem. Users specify each alternative by adding data to, modifying, and deleting data from the base problem.

INVEST V users should determine the best way to organize data before creating an input data file. A cash-flow diagram or similar presentation can help users organize their data. All program features in INVEST V apply to base problems and to alternatives. Users should seek the optimal combination of base problems and alternatives. A single run of INVEST V is limited as follows:

Number of base problems: 1 to n_1
Number of alternatives to base problems: 1 to n_2
... such that $n_1 + n_2 \leq 100$

Whether users choose to organize data around multiple base problems or around multiple alternatives depends on how similar the investment opportunities are. In general, if the investment opportunities are totally dissimilar, enter each opportunity as a separate base problem. If they are very similar, consider a base problem with multiple alternatives. If the opportunities are mixed, users may wish to enter opportunities that are the most different from one another as separate base problems, each with multiple alternatives. The primary reason INVEST V uses base problems is to efficiently specify data for alternatives. This advantage is apparent when several forestry investment opportunities have common cost or benefit items. Rather than repeatedly entering these common items, users can place them into a base problem and then fully specify each alternative by adding items unique to the alternative. The base problem will not represent an actual investment opportunity; the alternatives actually constitute the set of opportunities being evaluated. As users gain experience with INVEST V, the flexibility and significance of this feature will become increasingly clear.

The data file (INVEST.FOR) reproduced in appendix B illustrates the distinction between a base problem and alternatives. The fourth data line in the file initiates a base problem and begins "B 0 1"; "0 1" identifies the 0th alternative to base problem 1. The 10 data line initiates an alternative and begins "A 1 1"; "1 1" identifies the 1st alternative to base problem 1. That file was constructed with one base problem and one alternative.

Data Records—Sequence

INVEST V requires data input records to be sequenced in a specific order, each corresponding to a line of data. Records contain all data necessary for calculations and all text necessary to correctly label output.

INVEST V uses up to seven different types of records in a fully specified data input file:

Record type	Description
1	Identifies the first base problem and the organization using INVEST V.
2	Identifies the organization subunit.
3	Identifies the analyst's name.
4	Identifies a major level of a project or program. It is used to signal that a new base problem or alternative is to be specified. Also used to activate the A and B Comparisons feature (see Program Features).
5	Identifies the name of the specific investment opportunity being evaluated and provides information on discount rates and general price-level changes.
6	Provides data to fully specify one cost or benefit item, and to change, add, or delete data.
7	Activates the Sensitivity Analysis feature.

Certain rules govern the sequence of data record entries:

Situation	Record-type Sequence
Original base problem	Record-type 1 Record-type 2 Record-type 3 Record-type 4 Record-type 5 Record-type 6: use as many as appropriate Record-type 7: use as appropriate
First alternative to original base	Record-type 4 Record-type 5 Record-type 6: use as many as appropriate Record-type 7: use as appropriate
Other alternatives to original base	Same as first alternative to original base
Other base problems	Same as first alternative to original base
Alternatives to other base problems	Same as first alternative to original base

For a clearer understanding of record-type entries, refer to the data input file (INVEST.FOR) in appendix B. The first column of numbers in the file refers to record-type identifiers 1-7 and B-A (modification of record-type 4 to be discussed later). Each record type consists of a unique set of data attributes or fields. Appendix E is a coding form for use with INVEST V. The data called for are transcribed (without coding form labels) into a data input file (see appendix B).

Data Records—Required Information

INVEST V requires that data be organized in the specific columnar format outlined for each of the seven record types. If the data file is free formatted or constructed interactively, the columnar format is irrelevant. The sequence of data is still important; INVEST V software will properly format those data files. If a formatted data file is used, data organization rules must be followed. Data in numeric fields are always right-justified. Data are always left-justified in alphanumeric fields. The primary data input file may contain up to 990 individual records (record-types 1-7).

Record-type 1

Col. 1	Record-type identifier: Enter "1."
Col. 2-29	Forestry organization: Enter name of organization, using up to 28 alphanumeric characters, including spaces.
	NOTE: After the first base problem, record-type 1 is used to identify other new base problems.

Record-type 2

Col. 1	Record-type identifier: Enter "2."
Col. 2-29	Organizational subdivision: Enter name of department, division, district, or other unit, using up to 28 alphanumeric characters, including spaces.

Record-type 3

Col. 1 Record-type identifier: Enter "3."

Col. 2-29 Analyst: Enter name of analyst, using up to 28 alphanumeric characters, including spaces.

Record-type 4

Col. 1 Record-type identifier: Enter "4" (or "B" or "A").

NOTE: If the user wants to activate the A and B Comparisons feature of INVEST V (see Program Features section), the record-type identifier "4" is replaced by "B" for any base problem and by "A" for any alternative associated with the A and B Comparisons.

Col. 2-4 Alternative identifier: Enter "0" for every base problem; enter "1" for the first alternative to a specified base problem, "2" for the second alternative, and so forth for up to a total of 100 base problems and their alternatives.

Col. 5-8 Base problem identifier: Enter "1" for the first base problem, "2" for the second base problem, and so forth for up to a total of 100 base problems and their alternatives.

Col. 9-36 Project or program: Enter name or general description of problem being evaluated, using up to 28 alphanumeric characters, including spaces.

Record-type 5

Col. 1 Record-type identifier: Enter "5."

Col. 2-29 Base problem or alternative: Enter name or a specific description of the base problem or alternative that follows, using up to 28 alphanumeric characters, including spaces.

NOTE: Because this name is used extensively to label output, provide the most descriptive name possible. Include the project initiation date, if appropriate.

Col. 30-53 Annual-based percentages: Enter four percentages (see Discount Rates in Program Features section) as a decimal with zero, one, or two significant digits ranging from 0. to 999., or 0.00 to 999.99. Percentages can also be entered as integers without decimals; for instance, 10 instead of 10.00. A blank field implies 0.00 percent. INVEST V automatically uses discount rates of 4.00 and 7.00 percent.

Col. 30-35 Enter optional discount rate No. 1

Col. 36-41 Enter optional discount rate No. 2

Col. 42-47 Enter ranking discount rate. This may be one of five rates: 4.00, 7.00, optional No. 1, optional No. 2, or another specified ranking rate. Users should select the ranking rate as the rate of primary concern, because most INVEST V output will be computed on the basis of this rate.

Col. 48-53 Inflation rate: Enter change in the general level of prices. This feature is used only when the analysis is based on current dollars (see Discount Rates in Program Features section). For example, a 5 percent rate of inflation is entered 5.00, while a 3 percent rate of deflation is entered –3.00.

Record-type 6

Col. 1 Record-type identifier: Enter "6."

Col. 2-4 Item sequence number: Enter a "1" for the first item, "2" for the second item, and so forth, up to a total of 990 items (record-type 6) for any individual base problem or alternative and up to a combined total of 990 items (record-type 6) for all base problems and alternatives.

NOTE: Enter item numbers in sequence. Additional numbers needed to fully specify the first alternative to a base must begin with the number following the last number used in the base. Additional sequence numbers needed to fully specify the second alternative follow the last sequence number used on the first alternative, and so forth.

Each new base problem begins with item sequence number "1." Sequence numbers for subsequent alternatives follow as described.

Record-type 6 is used to change base problem data within an alternative to that base. To delete a base problem entry, enter data in columns 1-4, as described above, using the base problem sequence number; leave all other columns blank. To modify a base problem, enter all data as described in this section, but use the base problem sequence number (the item being modified) to identify the entry being changed.

A given sequence number may not be used more than once within a base problem or within an alternative to that base.

Changes to a base problem (data additions, deletions, or modifications) fully specifying a given alternative apply only to that alternative. To apply any or all of those changes to another alternative, each change must be repeated for each alternative.

Col. 5 Leave blank.

Col. 6-33 Item description: Enter a character string or text sufficient to label an item, by description and combination grouping, if desired. Two possibilities are available:

Enter a description only of the type of benefit or cost, beginning in column 8, using up to 26 alphanumeric characters, including spaces; leave columns 6-7 blank.

Enter the following sequence for the Combinations feature (see Program Features section):

Col. 6-7 A numeric code (1-99) indicating the type of transaction described as a benefit or cost. INVEST V will aggregate all items having the same transaction code and provide summary output. Codes must be used consistently.

Col. 8-33 A description of the type of benefit or cost, using up to 26 alphanumeric characters, including spaces.

NOTE: Users may mix the description only with the Combinations feature within a base problem or alternative.

The Combinations feature coding system for a base problem must also be used for an alternative. Different base problems can have different Combinations feature coding systems.

Col. 34-35 Payment-type: Enter a numeric payment-type code as follows:

Single payment: Enter "1"
Equal annual payment: Enter "2"
Constantly increasing annual payment: Enter "3"
Constantly decreasing annual payment: Enter "4"

NOTE: The cash-flow diagram profile of a constant change payment has a stair-step shape, up for the increasing payment and down for the decreasing payment. Each step represents 1 year.

Computations involving constant change (increase or decrease) assume that the first change occurs in the second year of the time period specified.

If the constant increase or decrease begins with a level other than zero, use two record-type 6 entries, one for the base and the second for the change. Proceed as follows: code the payment type of the initial level (the base must be greater than 0) as "2" for an equal annual payment; code the constant change (increase or decrease) "3" for increase or "4" for decrease (appendix B illustrates correct usage).

To activate the Opportunity Costs feature, the payment type should be preceded by the code "5." The opportunity cost codes for the above payment types are: 51, 52, 53, and 54.

To activate the Land Expectation Value (LEV) Item Exclusion feature, the payment type should be preceded by the code "8." The LEV Item Exclusion codes for the above payment types are: 81, 82, 83, and 84. To activate both the LEV Item Exclusion and Opportunity Cost features, the payment type should be preceded by the code "9." The opportunity cost codes for the above payment types are: 91, 92, 93, and 94.

Col. 36-43 Payment beginning and ending years:

Col. 36-39 Beginning: Enter the number for the first year in which a payment begins.

Col. 40-43 Ending: Enter the number for the year a payment ends.

NOTE: For a single payment (payment-type code "1"), enter the same year for the beginning and ending year.

INVEST V assumes that the present is year 0. Therefore, a payment discounted 1 year is coded "1" and a payment in the present is coded "0." For example, a series of 10 equal annual payments starting in the first year would be coded "1, 10".

Some organizational policies require analysts to assume that costs occur at the beginning of a year and that benefits occur at the end of the year. INVEST V can handle this situation. When INVEST V is executed, the user is asked whether the policy applies (see Cost Timing in the Program Features section). Because INVEST V internally compensates for cost timing, the user should routinely enter payment beginning and ending year data as discussed previously in this section. Caution: if costs are assumed to occur at the beginning of a year and a cost is immediate, the entry for payment beginning year cannot be 0; it must be entered as 1.

INVEST V uses the same discounting calculations for benefits and costs when all payments are assumed to occur at the end of a year. Although costs and benefits that are identical in all regards will offset each other in present net value calculations, they will not offset each other in other calculations, such as benefit/cost ratio. Therefore, enter individual cost and revenue data, as opposed to net revenue.

Col. 44-49 Increase Value Rate: Enter the annual percentage rate of real value (cost or price) increase (see Price Level and Real Value Change in the Program Features section) for the item specified. Data entry is the same as annual-based percentages, col. 30-53, for record-type 5.

Col. 50-80 Value specification: Provide item values by entering data in three fields: (1) acres, (2) units, and (3) value. INVEST V computes the aggregate value associated with an item by multiplying all fields together. INVEST V assumes a value of "1.00" if the acres or units fields are blank. The value field must not be left blank. The result of these multiplications, or the sum of all discounted values, cannot exceed 999,999,999,999,999.99.

NOTE: The user determines what data are to be entered in each field. Any of the following combinations may be used:

acres,	units,	value
acres,		value
	units,	value
		value

Because these fields are multiplied together, users are free to interpret each field as desired. The acres, units, and value labels and descriptions below are purely arbitrary.

Col. 50-58 Acres: Enter the number of acres as an eight-digit decimal number (maximum) with two significant digits ranging from 0.00 to 999,999.99 or as an integer from 0 to 999,999.

Col. 59-67 Units: Enter the number of units as an eight-digit decimal number (maximum) with two significant digits ranging from 0.00 to 999,999.99 or as an integer from 0 to 999,999.

Col. 68-80 Value: Enter the value as a 12-digit decimal number (maximum) with two significant digits as follows:

1. Benefits from 0.01 to 9,999,999,999.99.
2. Costs from 0.01 to –999,999,999.99. Values can also be integers.

NOTE: INVEST V distinguishes between costs and benefits on the basis of the sign of the number in the value field (col. 68-80). A minus sign (–) immediately precedes a cost item. A positive sign (+) is assumed for benefit items; it should not be entered. Because cost entries require a minus (–), the maximum cost is one digit less than the maximum benefit.

Record-type 7

Col. 1 Record-type identifier: Enter "7."

Col. 2-4 Item sequence number: Enter the sequence number of the item in a base problem or alternative to be sensitized (see Sensitivity Analysis in the Program Features section).

NOTE: Record-type 7 entries must be placed after record-type 6 entries. Multiple entries of record-type 7 must be entered in ascending order relative to sequence number. A sequence number may be sensitized only once in any particular base problem or alternative.

NOTE: The rules for modifying and deleting a record-type 7 base-problem entry within an alternative are the same as those specified for record-type 6.

Col. 5-74 Leave blank.

Col. 75-80 Sensitivity percentage: Enter percentage changes as a five-digit decimal number (maximum) with two significant digits from 0.00 to 999.99 percent or as an integer 0 to 999. If the percentage is a decrease, a minus sign (–) precedes the number. Otherwise, a positive sign is assumed. The product of acres times units times value is sensitized by instructing INVEST V to multiply the product by the specified percentage change; the sum of all discounted values must not exceed 999,999,999,999,999.99.

Program Features

To meet a wide variety of investment analysis needs, a number of special features have been built into INVEST V. As a user gains familiarity and experience with INVEST V, input data can be modified to permit other analyses for which INVEST V was not explicitly designed. Principal

examples include "after-tax" analysis and "break-even" analysis. For example, a simple after-tax analysis can be accomplished by reflecting tax rates in the acres or units field of record-type 6. INVEST V's range of application is limited by the user's expertise, imagination, and knowledge of existing program features.

Discount Rates

Discount rates reflect the cost of time, the opportunity cost of consuming later rather than sooner. Rates are expressed in terms of an annual rate of compound interest. INVEST V provides discounted value calculations on the basis of five discount rates: three specified by the user and two that are fixed. INVEST V automatically discounts at 4.00 and 7.00 percent. The 4-percent rate corresponds to the real discount rate specified in the Forest Service analysis policy (USDA Forest Service 1988); the 7-percent rate corresponds to the real discount rate specified by the Office of Management and Budget (Office of Management and Budget 1992). Users specify three additional rates: optional rate 1, optional rate 2, and a ranking rate (exhibit 1). Each rate has a value between 0.00 and 99.99 percent. The basis for selecting these rates is left to the user's discretion and judgment. For example, users may want to reflect a wide range of discount rates and specify very high and very low rates, or may want to use rates prescribed by the federal Water Resources Council. When INVEST V evaluates investment alternatives, it does so on the basis of calculations performed at each of these five rates.

Additionally, various tables produced by INVEST V are applicable to the specified ranking discount rate. Users should, therefore, specify the primary discount rate as the ranking rate, since it appears extensively in output tables.

Price Level and Real Value Changes

Changes in the general level of prices have long characterized the American economy. General price level increases are called inflation; decreases are called deflation. At the same time, certain commodities change in real value or price. Commodities increase in real value when they increase in value relative to the general level of prices. Real value decreases when commodity values increase by less than the general increase. INVEST V can deal with these situations. But users must be aware of the relationship between changes in the general level of prices and changes in the real value of a cost or revenue item, since these changes affect use of a discount rate.

At the user's discretion, discount rates can be interpreted as real (constant dollars without inflation or deflation) or current (nominal dollars with inflation or deflation) rates. Either type of rate may be appropriate, depending on users' intentions. But the approach to general price level change, real value change, and discount rate must be compatible and consistent. The approaches cannot be mixed. Record-type 5 consists of

```
1ST. JOE NATIONAL FOREST
2LONEPINE DISTRICT
3RANGER J. ARMSTRONG
B  0   1FORESTRY OPPORTUNITIES I
5TIMBER OUTPUT                    .00  5.00 10.00  3.00
```

Exhibit 1—Designating three user-specified discount rates (0, 5, and 10 percent).

user-specified discount rates and a change in the general level of prices (exhibit 2). Record-type 6 is used to specify change in the real value for the item of concern.

The tabulation below indicates how users should handle discount rates, inflation rates, and the rate of real value increase, depending on the type of analysis desired:

Item of concern	Analysis conducted on basis of: Current (nominal) dollars	Constant (real) dollars
	Enter	
Discount rate	Current discount rate	Real discount rate
Inflation rate	Price level change	0.0
Increase value rate	Increased value rate as appropriate	Increased value rate as appropriate

Users may want to deal in constant dollars but only know the price level change and current discount rates. The real discount rate is determined as follows:

$$RDR = \left\{\frac{(1 + CDR)}{(1 + PLC)}\right\} - 1$$

where: RDR = Real discount rate
CDR = Current discount rate
PLC = Price level change

For example, users may wish to use a real discount rate, but know only that the current discount rate is 10.0 percent and the annual rate of inflation is 6.0 percent. The real discount rate would be:

$$RDR = \left\{\frac{(1 + 0.10)}{(1 + 0.06)}\right\} - 1$$
$$= 1.03774 - 1$$
$$= 0.03774 = 3.77 \text{ percent}$$

Once users decide to employ real or current dollars, all INVEST V data entries should be consistent with that decision. The nature and appearance of output does not change when the price level and real value features are used.

INVEST V has no provision to reflect changes in discount, inflation, or real value rates over time. For example, the user may want to use a 7 percent inflation rate for the first 5 years of the analysis and 3 percent for the remaining 15 years. Similar changes could exist for real values and discount rates. But

```
1ST. JOE NATIONAL FOREST
2LONEPINE DISTRICT
3RANGER J. ARMSTRONG
B  0   1FORESTRY OPPORTUNITIES I
5TIMBER OUTPUT                  .00  5.00 10.00  3.00
6  1  1INITIAL HARVEST           81    0    0  2.00      .00     1.00       100.00
6  2  1PLANTING COST              1    1    1  0.00     1.00     1.00      -175.00
6  3  1FINAL HARVEST I            1   50   50  2.00    50.00    60.00         1.00
```

Exhibit 2—Specifying price level (3 percent) and real value change (2 percent).

INVEST V allows specification of only one rate, covering the entire analysis period. To approximate the desired result, calculate a "composite rate" (CR) for inflation, real values, and discount rates as follows:

$$(1 + CR)^n = (1 + r_a)^a(1 + r_b)^b...(1 + r_j)^j$$

where: $a, b, ..., j$ refer to the number of years associated with each percentage rate;

$a + b + ... + j = n$ (number of years for analysis period);

r_a = annual percentage rate for first "a" years expressed as a decimal (7 percent = 0.07); and

r_b = annual percentage rate for next "b" years expressed as a decimal (i.e., 3 percent = 0.03); and

r_j = annual percentage rate for last "j" years expressed as a decimal.

$$\therefore CR = \text{Antilog } [[\text{Log}((1 + r_a)^a(1 + r_b)^b...(1 + r_j)^j)]/n]-1$$

or

$$= \text{Antilog } [[a\text{Log}(1 + r_a) + b\text{Log}(1 + r_b) + ... + j\text{Log}(1 + r_j)]/n]-1$$

Consider again the example of inflation acting on an investment opportunity lasting for 20 years where a 7-percent inflation rate will prevail during the first 5 years and a 3-percent rate thereafter. The "composite rate" can be calculated as follows:

$$CR = \text{Antilog } [[\text{Log } ((1 + 0.07)^5 (1 + 0.03)^{15})]/20]-1$$

$$= 0.04 = 4 \text{ percent}$$

The composite rate calculated in the example above should be entered into INVEST V where appropriate, in this case the inflation rate entry (sixth data field in record-type 5). Note that because this procedure develops an aggregate rate, it will yield results identical to those of actual rates only when the distribution of costs and benefits is uniform over the project life. Nevertheless, it is the only way INVEST V can handle varying real value changes, discount rates, and inflation rates. Composite rates for increased value should be calculated for each item (record-type 6) such that "n" is the same as the payment ending year, as previously specified.

Investment Criteria

Alternative investment opportunities in forestry can be evaluated and compared on the basis of several criteria. One or more of these criteria may or may not be important or appropriate. For example, calculated Land Expectation values will not be correct if the user enters data for a partial rotation where timber volumes already exist. Because INVEST V has no way of determining which criteria are relevant, all INVEST V output is generated for each of the criteria. All calculations conducted by INVEST V use discount, inflation, and real value increase rates specified by the user. Computation formulas are based on Davis (1966) and Flick (1976). INVEST V computes the following criteria:

Present Net Value (PNV)—Summation of the discounted value of benefits minus summation of the discounted value of costs.
Also called discounted net value.
Calculated for project life.

Benefit-Cost Ratio (B/C)—Summation of the discounted value of benefits divided by the summation of the discounted value of costs.
Also called profitability index.
Calculated for project life.

Annual Equivalent Value (AEV)—The amount of an annual payment that will just pay off the present net value of the investment during its lifetime.

Also called equivalent annual income.

Calculated for project life.

Land Expectation Value (LEV)—Present net value of bare land for producing permanent periodic net income received at the end of each rotation, such as successive even-aged crops of timber.

Also called Faustmann formula.

Calculated for perpetual project lives.

Two land expectation values are calculated: LEV1 is calculated with specified inflation and real value changes continuing after the first rotation (project life); LEV2 is calculated without inflation and real value changes after the first rotation (project life).

Internal Rate of Return (IRR)—The average annual return on investment. It is also the discount rate when the present net value is zero. Note: internal rate of return calculations involving costs and benefits that occur in multiple time periods can generate multiple solutions; a unique solution does not exist. INVEST V calculates the internal rate of return by incrementing the discount rate in ascending steps starting at 0.0 until the present net value is zero. Therefore, if multiple solutions exist, INVEST V will identify the lowest internal rate of return and stop calculations.

Also called return on investment.

Three internal rates of return are calculated: IRR is calculated on the basis of present net value for the project life; IRR1 is calculated on the basis of LEV1; IRR2 is calculated on the basis of LEV2.

A and B Comparisons

Users can construct an investment problem where the base problem and alternatives are very similar in terms of cost and benefit items, differing mainly in the magnitude of cost and benefit values. In that case, users may want to see a detailed item-by-item listing of differences in discounted value between the base and alternative. This is accomplished through the A and B Comparisons feature. To activate this feature, enter a letter code "B" for any base problem and code "A" for any alternative for which comparisons are desired; these letter codes replace the record-type identifier in the first column of record-type 4 (exhibit 3). In all cases, the remaining columns are to be completed as discussed in the Data Organization section. The A and B Comparisons feature may be activated for any combination of base problems and for any alternative to identified base problems for which

```
1ST. JOE NATIONAL FOREST
2LONEPINE DISTRICT
3RANGER J. ARMSTRONG
B  0   1FORESTRY OPPORTUNITIES I
5TIMBER OUTPUT                  .00  5.00 10.00  3.00
6  1   1INITIAL HARVEST          81    0    0  2.00      .00     1.00       100.00
6  2   1PLANTING COST             1    1    1  0.00     1.00     1.00      -175.00
6  3   1FINAL HARVEST I           1   50   50  2.00    50.00    60.00         1.00
7  1                                                                      -50.00
A  1   1FORESTRY OPPORTUNITIES II
5MULTIPLE OUTPUT                .00  5.00 10.00  3.00
```

Exhibit 3—Initiating A and B Comparisons feature with record-type codes B and A.

detailed differences are desired. The A and B Comparisons feature can only be activated for base problems that have alternatives. INVEST V uses the item sequence number of record-type 6 in the base problem to calculate all differences. Therefore, the item sequence number of the base problem and the alternative must describe the same kind of cost or benefit. All comparisons between a base problem and alternatives are performed on the basis of their respective ranking discount rates (exhibit 4). To make comparisons based on the same discount rate, the same ranking rate should be specified for a base problem and any alternatives for which comparisons are desired.

Combinations

Under certain circumstances, INVEST V's users may want to analyze complex problems on the basis of aggregations of similar items, instead of analyzing them item by item. For example, users may want to group all transportation-related items and compare them to all other items. Alternatively, users may want to group items in resource categories—timber, recreation, and so on. Users can identify up to 99 different grouping categories. The code for each category is a number (1-99) and is entered in the item description portion of record-type 6 for a base problem or alternative (exhibit 5). The Combinations feature is flexible and can be used for any or for all base problems and alternatives. Moreover, users may group certain items, but not others. In this case, the combined items will appear as a group and all other items will appear individually on the output (exhibit 6). If no items are combined, every item will appear individually in output

```
++++++++++++++++++++++++++++++++++++++++++++++
+           A AND B COMPARISONS              +
+    BASED ON RESPECTIVE RANKING RATES       +
+ FOR PROBLEM: MULTIPLE OUTPUT               +
++++++++++++++++++++++++++++++++++++++++++++++
```

NOTE: WHEN EITHER THE ABSOLUTE VALUE OF A COST OR BENEFIT ITEM FOR THE ALTERNATIVE IS GREATER THAN THAT OF THE BASE, THE DIFFERENCE WILL BE POSITIVE. LIKEWISE WHEN THE ABSOLUTE VALUE IS LESS THAN THAT OF THE BASE, THE DIFFERENCE WILL BE NEGATIVE(-)

ALTERNATIVE: MULTIPLE OUTPUT — DISCOUNTED AT 10.00%
VERSUS BASE: TIMBER OUTPUT — DISCOUNTED AT 10.00%

SEQ. NO.	ITEM	ABS($ALT)-ABS($BASE) COST	BENEFIT
1	INITIAL HARVEST		-100.00
3	FINAL HARVEST I		76.40
4	COMMERCIAL THIN		199.46
5	HUNTING LEASE		14.56
6	FISHING LEASE--BASE		5.82
7	FISHING LEASE--INCREASE		6.33
8	CAMPING SITE	193.63	
9	INITIAL HARVEST		50.00
10	FINAL HARVEST--II		62.99
		---	---
DISCOUNTED NET CHANGE FROM BASE =		193.63	315.57
	CHANGE IN PNV:	121.94	

Exhibit 4—Output from A and B Comparisons feature.

```
A  1   1FORESTRY OPPORTUNITIES II
5MULTIPLE OUTPUT                .00  5.00 10.00  3.00
6  1
6  3  1FINAL HARVEST--I            1  30  30  2.00     1.00     1.00      1500.00
6  4  1COMMERCIAL THIN             1  20  20  2.00     1.00     1.00       500.00
6  5  2HUNTING LEASE               2   5  15   .00     1.00     1.00         2.50
6  6  2FISHING LEASE--BASE         2   5  15   .00     1.00     1.00         1.00
6  7  2FISHING LEASE--INCREASE     3   5  15   .00     1.00     1.00          .25
6  8  3CAMPING SITE               52   5  15   .00     1.00     1.00       -33.25
6  9  1INITIAL HARVEST             1   0   0  2.00      .00     1.00        50.00
6 10   FINAL HARVEST--II           1  30  30  2.00     1.00     1.00       250.00
```

Exhibit 5—Identifying three groups (1, 2, and 3) for Combinations feature.

```
++++++++++++++++++++++++++++++++++++++++++++++
+      COMBINATIONS FEATURE REPORT           +
+        LISTING OF COMBINED ITEMS           +
+          DISCOUNTED AT  10.00%             +
+ FOR PROBLEM: MULTIPLE OUTPUT               +
++++++++++++++++++++++++++++++++++++++++++++++

SEQ.      COMBINATION
 NO.          NO.              DESCRIPTION                    COST          BENEFIT
----      -----        --------------------------          ----------    ----------

                1                                          -163.86          627.41
                2                                             0.00           26.71
                3                                          -193.63            0.00
 10                          FINAL HARVEST--II                0.00           62.99
                                                          ----------    ----------
                                              TOTALS =     -357.50          717.12
```

Exhibit 6—Output from Combinations feature.

tables on the basis of sequence number. INVEST V output will always contain a heading corresponding to a description of the combined items. Space below this heading will be blank so the user can write or type the appropriate combination description.

Opportunity Costs

Opportunity costs are represented by the value of the benefits foregone because one alternative is chosen rather than the next best alternative. In a well-functioning, competitive, market economy, these costs will be equal to the budgetary outlay for economic resources associated with the chosen alternative. But because markets do not always function properly, budgetary outlays may not account for all of the values foregone. This is particularly important for nonmarket commodities, whether they are costs or benefits. INVEST V allows the user to reflect nonmarket costs through the Opportunity Costs feature. Data entry for opportunity costs is identical to any other cost, with one exception—the code used to identify the type of payment is preceded by a "5." A payment-type cost "1" becomes "51", "2" becomes "52", and so on (exhibit 7). INVEST V will include all opportunity costs in normal calculations. In addition, all opportunity costs discounted at the ranking rate are printed (exhibit 8). The change in present net value and internal rate of return (without opportunity costs) is calculated and printed.

```
A  1   1FORESTRY OPPORTUNITIES II
5MULTIPLE OUTPUT                .00  5.00 10.00  3.00
6  1
6  3  1FINAL HARVEST--I            1  30  30  2.00     1.00     1.00      1500.00
6  4  1COMMERCIAL THIN             1  20  20  2.00     1.00     1.00       500.00
6  5  2HUNTING LEASE               2   5  15   .00     1.00     1.00         2.50
6  6  2FISHING LEASE--BASE         2   5  15   .00     1.00     1.00         1.00
6  7  2FISHING LEASE--INCREASE     3   5  15   .00     1.00     1.00          .25
6  8  3CAMPING SITE               52   5  15   .00     1.00     1.00       -33.25
6  9  1INITIAL HARVEST             1   0   0  2.00      .00     1.00        50.00
6 10   FINAL HARVEST--II           1  30  30  2.00     1.00     1.00       250.00
```

Exhibit 7—Identifying "camping site" as an opportunity cost with payment-type 52.

```
++++++++++++++++++++++++++++++++++++++++++++++
+          OPPORTUNITY COST REPORT           +
+ FOR PROBLEM: MULTIPLE OUTPUT               +
++++++++++++++++++++++++++++++++++++++++++++++

                                  BEGINNING YEAR
SEQ.                               NONDISCOUNTED   $ DISCOUNTED AT 10.00%
 NO.        ITEM                     TOTAL VALUE       COST OR BENEFIT
----        ----                     -----------       ---------------

  8   CAMPING SITE                        -33.25               -193.63

          CHANGE IN PROJECT PNV:                193.63 (WITHOUT OPPORTUNITY COSTS)

          INTERNAL RATE OF RETURN:   IRR =   18.67% (WITHOUT OPPORTUNITY COSTS)
```

Exhibit 8—Output from Opportunity Cost feature.

Cost Timing

Investment analyses commonly employ a specific assumption concerning the timing of costs and benefits. The issue is determining when the payments will be made within a year. Two possibilities exist: payments either occur at the beginning of a year or at the end of a year. INVEST V provides the user with two options: (1) costs and benefits both occur at the end of a year, (2) costs occur at the beginning of a year while benefits occur at the end. Users indicate the appropriate cost-timing option when INVEST V is executed by responding to a question posed by the computer program (exhibit 9). The user must choose one option that will apply to all cost and benefit items during a particular execution of INVEST V. The user can employ a different assumption the next time INVEST V is executed.

Sensitivity Analysis

For a wide variety of reasons, users may want to evaluate how a change in the value of a particular cost or benefit item (input) would change the

```
NOTE: BENEFITS ARE ALWAYS ASSUMED TO OCCUR AT THE END OF THE YEAR
     DO YOU WANT COSTS TO OCCUR AT:
         1 => END OF YEAR
         2 => BEGINNING OF YEAR
ENTER COST-TIMING CODE: 1
```

Exhibit 9—Specifying that costs are to occur at end of year with response 1.

analysis outcome (how sensitive the outcome is to input changes). For example, users can assess the impact that a 25-percent increase in timber yield would have on a base problem or that a 10-percent decrease in grazing fees would have on an alternative. This can be accomplished either by creating another alternative containing the new piece of data or by activating the Sensitivity Analysis feature. Although this feature is implemented through record-type 7, sensitization is actually performed on a specific record-type 6 cost or benefit item. Total costs or total benefits for record-type 6 are the product of acres x units x value. Sensitivity analysis specifications in a record-type 7 identify a specific record-type 6 item and specify a percentage change in total benefits or total cost (exhibit 10). INVEST V computes and prints results related to the unsensitized base problem or alternative and performs a two-part sensitivity analysis resulting in: (1) the change in present net value from the alternative or base being sensitized, and (2) the new internal rate of return (exhibit 11). This new, sensitivity-based internal rate of return is not used in project rankings.

The Sensitivity Analysis feature can be applied to a base problem and to any alternatives. If a base problem is sensitized, those sensitivity values apply to record-type 6 data retained in any alternatives to that base; sensitivity values appearing in a base apply to all alternatives. But if an alternative is sensitized, users must sensitize new record-type 6 data added to any alternative; sensitivity values appearing in an alternative apply only to that alternative. Users can sensitize all items for an alternative to the base problem. This is accomplished by a series of record-type 7 entries sensitizing each original entry for the base problem and each new entry for the alternative. Whenever multiple record-type 7 entries are used, they must be arranged consecutively by item sequence number. When users sensitize more than one item in a base problem or alternative, INVEST V will compute

```
5TIMBER OUTPUT                .00  5.00 10.00  3.00
6  1  1INITIAL HARVEST         81    0    0  2.00      .00     1.00       100.00
6  2  1PLANTING COST            1    1    1  0.00     1.00     1.00      -175.00
6  3  1FINAL HARVEST I          1   50   50  2.00    50.00    60.00         1.00
7  1                                                                      -50.00
```

Exhibit 10—Designating sensitivity analysis (—50 percent) for item sequence number 1 with record-type 7.

```
++++++++++++++++++++++++++++++++++++++++++++
+        SENSITIVITY ANALYSIS REPORT       +
+ FOR PROBLEM: TIMBER OUTPUT               +
++++++++++++++++++++++++++++++++++++++++++++
```

SEQ. NO.	ACRE, UNIT OR VALUE CHANGE	$ CHANGE IN DISCOUNTED VALUE COST	BENEFIT	BENEFIT-COST RATIO 10.00%	PRESENT NET VALUE AT 10.00%	IRR
1	-50.00%	0.00	-50.00	2.15	187.68	12.22%
SENSITIZED PROJECT TOTALS:		0.00	-50.00	2.15	187.68	12.22%

Exhibit 11—Output from Sensitivity Analysis feature.

the change in discounted value for each item together with a new internal rate of return for the base problem or alternative, considering each sensitized item separately; it will also aggregate all sensitivity items into one composite sensitivity analysis and calculate an aggregate change in present net value and a new internal rate of return for the base problem or alternative.

Ranking Alternatives

Some INVEST V users will want to assess a single investment opportunity, independent of alternatives. In this case, INVEST V's ranking feature is unimportant. But it is helpful to rank alternatives when comparing the outcomes of multiple base problems, multiple alternatives to a base problem, or multiple base problems with multiple alternatives. When an INVEST V problem contains two or more projects (multiple base problems or alternatives), the ranking feature is automatically activated. Rankings of base problems and alternatives are provided based on the following investment criteria, each of which is defined and discussed in the Investment Criteria subsection: Present Net Value (PNV), Benefit-Cost Ratio (BCR), Annual Equivalent Value (AEV), Internal Rate of Return (IRR, IRR1, and IRR2), Land Expectation Value (LEV1 and LEV2), PNV of nonrotation items plus discounted LEV (LEV1 and LEV2).

Only users know which criterion is appropriate to the decision being evaluated. Moreover, the rankings of mutually exclusive investment opportunities may differ, depending on the ranking criteria.

Land Expectation Value Item Exclusion

Users may wish to assess the land expectation value (LEV) of future rotations within the context of an existing stand. The next rotation will begin at some time after conversion of the existing stand. Since land expectation value corresponds to bare land, it is necessary to distinguish between activities (record-type 6 items) associated with the existing stand and those of the next and subsequent rotations. The LEV Item Exclusion feature accomplishes this task. Users simply identify nonrotation items by means of special payment-type codes. Any item so coded will be excluded from land expectation value calculations. Normal payment-type codes 1, 2, 3, and 4 are preceded by 8 to become 81, 82, 83, and 84 (exhibit 12). If an LEV-excluded item is also an opportunity cost, it is preceded by a 9 (rather than a 5) to become 91, 92, 93, and 94. INVEST V screens out all items with 8+ and 9+ payment-type codes to identify the remaining item with the smallest payment in the beginning of the year. That year will be defined as year 0 of the next rotation. When users implement the item exclusion feature, INVEST V performs calculations on LEV-excluded items separately from items included in land expectation value. It calculates and displays the present net value of excluded items and the land expectation value of included items for year 0 of the next rotation. INVEST V discounts that land expectation value to the present and adds the present net value of excluded items. For timber, the total corresponds to the land plus timber value.

```
5TIMBER OUTPUT                .00  5.00 10.00  3.00
6  1  1INITIAL HARVEST         81    0    0  2.00      .00     1.00      100.00
6  2  1PLANTING COST            1    1    1  0.00     1.00     1.00     -175.00
6  3  1FINAL HARVEST I          1   50   50  2.00    50.00    60.00        1.00
```

Exhibit 12—Excluding "initial harvest" from LEV calculations with payment-type 81.

Marginal Analysis

If two or more projects (base problems and alternatives) are processed by INVEST V, a marginal analysis summary is calculated automatically. INVEST V places all projects in ascending order of total discounted costs, based on respective ranking rates. It then calculates the change in cost and benefit associated with increasingly costly projects. Projects evaluated in the Marginal Analysis consist of all base problems and all alternatives identified in the data input file, with each treated as a separate project. A marginal analysis is especially important if the projects being evaluated are mutually exclusive and differ in terms of investment or expenditure. Users determine if the summary is appropriate or meaningful.

Data Input and Output

INVEST V is executed by typing "INVEST" at the appropriate DOS prompt (microcomputer version) or on the appropriate command line in the IS (Information System program) on the Forest Service's Data General (DG) computers. INVEST V is not case sensitive, meaning upper- and lower-case characters can be used and mixed. Because INVEST V output is upper-case, the user may want to mix upper- and lower-case characters to distinguish information entered by the user from INVEST V output. Input and output file names may contain up to 30 alphanumeric characters. For microcomputer users, file names may include path specifications. For DG users, file names must follow DG conventions; input files must be located, and output files will be stored in the drawer and folder from which INVEST V is executed. If INVEST V is terminated during execution (^C for the microcomputer version and ^C^B for the DG version), partial input or output files will have been developed and stored, as named.

Users can pass input data to INVEST V by: the interactive data-entry mode, if an input data file does not already exist; and either the free- or fixed-format mode, when a data input file already exists. The mode is selected when the program is executed by the user's response to a question about the existence of a data input file. Afterward, the user specifies the timing assumption for cost data (see Cost Timing in the Program Features section). Because INVEST V contains no mechanism for sorting data records, the sequence of record types in the input data file must follow that described in the Data Organization section, no matter how data is entered.

Interactive Data Entry

Using this method for input (see appendix A), the user develops a fixed-format data file by responding to a series of program prompts displayed on the computer monitor. Users indicate that a data input file does not exist; INVEST V then proceeds with interactive data entry. The ensuing series of questions and responses create a fixed-format data file, for which the user must provide a name. The sequence of questions (from INVEST V) and responses (by the users) follow the same order of information and record type discussed in the Data Organization section. While the response requested is generally self-explanatory, users are encouraged to complete an INVEST V Coding Form (see appendix E) before execution. When multiple data fields are entered, the fields must be separated by commas. After responding to a data request (an INVEST V question), press the ENTER (or NEW LINE) key to end that line of data and invoke the next statement from INVEST V. This process continues until all necessary data have been entered. When data entry is complete, type "END."

Errors may occur. If a data entry error is discovered before the ENTER key is pressed, simply press the BACKSPACE (or DELETE) key until the appropriate number of characters have been deleted and re-enter the correct data. If the user makes format or procedural errors and presses the ENTER key, the INVEST V will not accept the data; an error message will appear; the user will be instructed to re-enter the correct data. If an error does not violate any procedural or format rule, INVEST V will accept the incorrect data and perform operations on them. Incorrect data can be corrected by editing the fixed-format data file created by INVEST V with an external text editor.

When data entry is complete, INVEST V lists the newly created fixed-format data file and asks the user if the file is error free. If the file is acceptable, the user is asked to name the output file and execution proceeds. If the user indicates the data input file has errors, INVEST V execution terminates. The user can edit the stored input data file with an external text editor or reinitiate the interactive data entry mode.

Existing Data Input File

In this mode, a data input file exists before INVEST V is executed, in either free or fixed format. In the fixed-format form, data must be placed exactly in certain fields (columns) within a record type (see the Data Organization section or the Coding Form in appendix E). In the free-format form, data entries within a particular record type are compressed, separated only by commas. In either data form, record types must be in the sequence described in the Data Organization section. The user creates either a fixed- or free-format data input file with external software, such as a word processor, spread sheet, or data base manager. Regardless of the software used, the file must be stored in an ASCII (text) format. Once the data input file has been created, either mode can be used when the INVEST V program is executed. With the free-format form, INVEST V creates the associated fixed-format file and prompts the user to provide a file name. Appendixes B and C show examples of input data files and program execution.

Input Data Verification and Editing

Users should always verify that data in the input file correctly portray the investment opportunity being analyzed. However, if an investment analysis problem involves alternatives, the primary data input file (free or fixed format) contains records only for those alternatives that differ from the base problem. Although this convention makes data entry easier, it makes data verification more difficult. However, INVEST V always creates an intermediate data input file (WORK.DAT) containing a complete set of data for each of the alternatives to the base problem. This working file is the one ultimately processed by INVEST V. It is stored in the subdirectory containing INVEST V. To verify that each alternative contains the desired data, inspect a listing of the WORK.DAT file. Never edit the WORK.DAT file, because it is created from the fixed-format data file each time INVEST V is executed. In the case of fixed-format or interactive data entry, the fixed-format data file should be edited. In the case of the free-format input file, that file or the fixed-format file (created by INVEST V) should be edited, whichever is more convenient.

Two conventions can make data entry easier; one involves zeros and the other decimal points. INVEST V users may find it bothersome to continually enter the number 0 into data input files. This is not necessary. INVEST V automatically treats missing entries as a 0. The following data illustrate these conventions:

Format	Data
Fixed-format (full)—	1 0 2.6 0.0 B
Fixed-format (abbreviated)—	1 2.6 B
Free-formatted (full)—	1, 0, 2.6, 0.0, B
Free-formatted (abbreviated)—	1,,2.6,,B
Interactive (abbreviated)—	1,,2.6,,B

Similarly, if decimal points are not needed to describe a number, they need not be entered. The following are equivalent: 14.70 and 14.7, 3.0 and 3, 5.000 and 5.

Obtaining Output

INVEST V output is written to a file specified by the user and must be printed outside INVEST V. The output file is a text or ASCII file, organized to be printed on 11- by 15-inch computer paper. Users wishing to print on 8.5- by 11-inch paper should print in compressed mode or landscape format. For example, microcomputer-version users could import an output file (INVEST.OUT) into word processing software (WordPerfect), select a laser printer (HP LaserJet III), and specify a small-pitch font (Line Printer 16.67 cpi); such a procedure will print INVEST V output on 8.5- by 11-inch paper in compressed, portrait mode. Similarly, DG-version users can print on 8.5- by 11-inch paper with a laser printer (HP LaserJet III in this example) and the appropriate print command, such as "PLaser/BATCH/TYPE=HPLJIII/LMO=0/CPI=17/QUE=quename INVEST.OUT", where "quename" is the name of the que-printer; this procedure can print INVEST V output in compressed, portrait mode. Consult the printer operating instructions for specific details.

Acquiring INVEST V

INVEST V is available in a microcomputer version and a DG version. Users can obtain the microcomputer version on 3.5-inch diskette by writing: Publications Distribution, Intermountain Research Station, Federal Building, 324 25th Street, Ogden, UT 84401. The phone number is (801) 625-5437. The DG address is Pubs:S22A.

The Data General version of INVEST V can be obtained by the DG RIS procedure in IS (Information System):

MAIN MENU
(3) Utilities
(6) Retrieval and DCC Access
(1) Retrieval
Location of file to be retrieved
Host name: S22L01A
(1.Public 2.Staff): 2 Staff Name: ECON
Drawer Name: INVEST
Folder Name: DUMP_FILE
File Name: INVEST.DMP

The INVEST dump file is loaded by first placing INVEST.DMP in the drawer and folder where executable files reside. (This may or may not be the location from which INVEST V will be executed.) Next, load INVEST.DMP from the Main Menu in IS:

```
MAIN MENU
  (3) Utilities
    (4) Load Dumpfile(s)
      Level (1.Public, 2.Staff, 3.Personal): ?
      Drawer Name: ?
      Folder Name: ?
      Dumpfile Name: INVEST.DMP
```

The Level, Drawer Name, and Folder Name should be where INVEST.DMP is stored. The diskette or dump file will contain the INVEST V executable file and the data file, INVEST.FOR, used throughout this guide.

References

Davis, Kenneth P. 1966. Forest management: regulation and valuation. New York: McGraw-Hill. 519 p.

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Appendix A: Interactive Data Entry

```
C:\SUBDIR\INVEST

HAS A DATA INPUT FILE BEEN CREATED (YES OR NO)? NO

*** INTERACTIVE DATA INPUT ASSUMED ***
ENTER NAME OF FORMATTED FILE TO BE CONSTRUCTED: INVEST.FOR

NOTE: BENEFITS ARE ALWAYS ASSUMED TO OCCUR AT THE END OF THE YEAR
     DO YOU WANT COSTS TO OCCUR AT:
         1 => END OF YEAR
         2 => BEGINNING OF YEAR
ENTER COST-TIMING CODE: 1


NOTE: THE FOLLOWING RECORD-TYPES SHOULD BE USED:

     SITUATION               REQUIRED RECORD-TYPE SEQUENCE
     ---------               -------- ---------- --------
     ORIGINAL BASE PROBLEM   RECORD-TYPE 1
                             RECORD-TYPE 2
                             RECORD-TYPE 3
                             RECORD-TYPE 4 (OR B IF APPROPRIATE)
                             RECORD-TYPE 5
                             RECORD-TYPE 6...USE AS MANY AS APPROPRIATE
                             RECORD-TYPE 7...USE AS APPROPRIATE

     ALL OTHER SITUATIONS    RECORD-TYPE 4 (OR A OR B AS APPROPRIATE)
                             RECORD-TYPE 5
                             RECORD-TYPE 6...USE AS MANY AS APPROPRIATE
                             RECORD-TYPE 7...USE AS APPROPRIATE

     PROBLEM ENDING          END


                *** PRESS THE "ENTER" KEY TO CONTINUE. ***

NOTE: THE FOLLOWING PAYMENT-TYPE CODES SHOULD BE USED WITH RECORD-TYPE 6:

                                                    LEV ITEM EXCLUSION
                             NORMAL   OPPORTUNITY    NORMAL   OPPORTUNITY
     SITUATION                CODE     COST CODE      CODE     COST CODE
     ---------               ------   ----------    ------   ----------
     SINGLE PAYMENT             1         51           81         91
     EQUAL ANNUAL               2         52           82         92
     CONSTANTLY INCREASING      3         53           83         93
     CONSTANTLY DECREASING      4         54           84         94



ENTER RECORD-TYPE IDENTIFIER: 1

ENTER NAME OF FORESTRY ORGANIZATION (28 CHARACTERS MAXIMUM):
ST. JOE NATIONAL FOREST

ENTER RECORD-TYPE IDENTIFIER: 2

ENTER NAME OF ORGANIZATION SUBDIVISION (28 CHARACTERS MAXIMUM):
LONEPINE DISTRICT

ENTER RECORD-TYPE IDENTIFIER: 3

ENTER NAME OF ANALYST (28 CHARACTERS MAXIMUM):
RANGER J ARMSTRONG
```

```
ENTER RECORD-TYPE IDENTIFIER: 8

ENTER ALTERNATIVE NUMBER AND BASE PROBLEM NUMBER:
0,1

ENTER NAME OF INVESTMENT PROJECT OR PROGRAM (28 CHARACTERS MAXIMUM):
FORESTRY OPPORTUNITIES I

ENTER RECORD-TYPE IDENTIFIER: 5

ENTER THE NAME OF BASE PROBLEM OR ALTERNATIVE (28 CHARACTERS MAXIMUM):
TIMBER OUTPUT

ENTER 4 PERCENTAGE RATES -- OPT1,OPT2,RANKING,INFLATION
       NOTE -- 4% AND 7% ARE AUTOMATICALLY PROVIDED
       EXAMPLE -- 7.75,10.,4.0,5.00

0.00,5.0,10.0,3.00

ENTER RECORD-TYPE IDENTIFIER: 6

ENTER OPTIONAL COMBINATION NUMBER (UP TO 2 DIGITS) FOLLOWED BY
ITEM DESCRIPTION (26 CHARACTERS MAXIMUM),(E.G., 16PLANTING COST):
1INITIAL HARVEST

ENTER 4 INTEGER CODES -- SEQ. NO., PAYT. TYPE, PAYT. BEGIN, PAYT. END
      4 DECIMAL CODES -- ANNUAL VALUE INCREASE %, ACRES, UNITS, VALUE
      EXAMPLE 1: 12,1,0,150,5.,1.0,1.0,-25.25
      EXAMPLE 2: 3,0,0,0,0.,0.,0.,0.

      EXAMPLE 2 SHOWS HOW TO ELIMINATE A PARTICULAR SEQUENCE NUMBER (E.G., 3)
      THAT EXISTS IN A BASE FROM THE ALTERNATIVE.

1,81,0,0,2.,0.,1.,100.

ENTER RECORD-TYPE IDENTIFIER: 6

ENTER OPTIONAL COMBINATION NUMBER (UP TO 2 DIGITS) FOLLOWED BY
ITEM DESCRIPTION (26 CHARACTERS MAXIMUM),(E.G., 16PLANTING COST):
1PLANTING COST

ENTER 4 INTEGER CODES -- SEQ. NO., PAYT. TYPE, PAYT. BEGIN, PAYT. END
      4 DECIMAL CODES -- ANNUAL VALUE INCREASE %, ACRES, UNITS, VALUE
      EXAMPLE 1: 12,1,0,150,5.,1.0,1.0,-25.25
      EXAMPLE 2: 3,0,0,0,0.,0.,0.,0.

      EXAMPLE 2 SHOWS HOW TO ELIMINATE A PARTICULAR SEQUENCE NUMBER (E.G., 3)
      THAT EXISTS IN A BASE FROM THE ALTERNATIVE.

2,1,1,1,0.,1.,1.,-175.

ENTER RECORD-TYPE IDENTIFIER: 6

ENTER OPTIONAL COMBINATION NUMBER (UP TO 2 DIGITS) FOLLOWED BY
ITEM DESCRIPTION (26 CHARACTERS MAXIMUM),(E.G., 16PLANTING COST):
1FINAL HARVEST

ENTER 4 INTEGER CODES -- SEQ. NO., PAYT. TYPE, PAYT. BEGIN, PAYT. END
      4 DECIMAL CODES -- ANNUAL VALUE INCREASE %, ACRES, UNITS, VALUE
      EXAMPLE 1: 12,1,0,150,5.,1.0,1.0,-25.25
      EXAMPLE 2: 3,0,0,0,0.,0.,0.,0.

      EXAMPLE 2 SHOWS HOW TO ELIMINATE A PARTICULAR SEQUENCE NUMBER (E.G., 3)
      THAT EXISTS IN A BASE FROM THE ALTERNATIVE.

3,1,50,50,2.,50.,60.,1.
```

```
ENTER RECORD-TYPE IDENTIFIER: 7

ENTER SEQUENCE NUMBER (INTEGER) AND % SENSITIVITY (DECIMAL):
1,-50.0

ENTER RECORD-TYPE IDENTIFIER: A

ENTER ALTERNATIVE NUMBER AND BASE PROBLEM NUMBER:
1,1

ENTER NAME OF INVESTMENT PROJECT OR PROGRAM (28 CHARACTERS MAXIMUM):
FORESTRY OPPORTUNITIES II

ENTER RECORD-TYPE IDENTIFIER: 5

ENTER THE NAME OF BASE PROBLEM OR ALTERNATIVE (28 CHARACTERS MAXIMUM):
MULTIPLE OUTPUT

ENTER 4 PERCENTAGE RATES -- OPT1,OPT2,RANKING,INFLATION
        NOTE -- 4% AND 7% ARE AUTOMATICALLY PROVIDED
        EXAMPLE -- 7.75,10.,4.0,5.00
0.00,5.0,10.0,3.00

ENTER RECORD-TYPE IDENTIFIER: 6

ENTER OPTIONAL COMBINATION NUMBER (UP TO 2 DIGITS) FOLLOWED BY
ITEM DESCRIPTION (26 CHARACTERS MAXIMUM),(E.G., 16PLANTING COST):


ENTER 4 INTEGER CODES -- SEQ. NO., PAYT. TYPE, PAYT. BEGIN, PAYT. END
      4 DECIMAL CODES -- ANNUAL VALUE INCREASE %, ACRES, UNITS, VALUE
      EXAMPLE 1: 12,1,0,150,5.,1.0,1.0,-25.25
      EXAMPLE 2: 3,0,0,0,0.,0.,0.,0.

      EXAMPLE 2 SHOWS HOW TO ELIMINATE A PARTICULAR SEQUENCE NUMBER (E.G., 3)
      THAT EXISTS IN A BASE FROM THE ALTERNATIVE.

1,0,0,0,0..0.,0.,0.

ENTER RECORD-TYPE IDENTIFIER: 6

ENTER OPTIONAL COMBINATION NUMBER (UP TO 2 DIGITS) FOLLOWED BY
ITEM DESCRIPTION (26 CHARACTERS MAXIMUM),(E.G., 16PLANTING COST):
1FINAL HARVEST--I

ENTER 4 INTEGER CODES -- SEQ. NO., PAYT. TYPE, PAYT. BEGIN, PAYT. END
      4 DECIMAL CODES -- ANNUAL VALUE INCREASE %, ACRES, UNITS, VALUE
      EXAMPLE 1: 12,1,0,150,5.,1.0,1.0,-25.25
      EXAMPLE 2: 3,0,0,0,0.,0.,0.,0.

      EXAMPLE 2 SHOWS HOW TO ELIMINATE A PARTICULAR SEQUENCE NUMBER (E.G., 3)
      THAT EXISTS IN A BASE FROM THE ALTERNATIVE.

3,1,30,30,2.,1.,1.,1500.

ENTER RECORD-TYPE IDENTIFIER: 6

ENTER OPTIONAL COMBINATION NUMBER (UP TO 2 DIGITS) FOLLOWED BY
ITEM DESCRIPTION (26 CHARACTERS MAXIMUM),(E.G., 16PLANTING COST):
1COMMERCIAL THIN

ENTER 4 INTEGER CODES -- SEQ. NO., PAYT. TYPE, PAYT. BEGIN, PAYT. END
      4 DECIMAL CODES -- ANNUAL VALUE INCREASE %, ACRES, UNITS, VALUE
      EXAMPLE 1: 12,1,0,150,5.,1.0,1.0,-25.25
      EXAMPLE 2: 3,0,0,0,0.,0.,0.,0.
```

```
      EXAMPLE 2 SHOWS HOW TO ELIMINATE A PARTICULAR SEQUENCE NUMBER (E.G., 3)
      THAT EXISTS IN A BASE FROM THE ALTERNATIVE.

4,1,20,20,2.,1.,1.,500.

ENTER RECORD-TYPE IDENTIFIER: 6

ENTER OPTIONAL COMBINATION NUMBER (UP TO 2 DIGITS) FOLLOWED BY
ITEM DESCRIPTION (26 CHARACTERS MAXIMUM),(E.G., 16PLANTING COST):
2HUNTING LEASE

ENTER 4 INTEGER CODES -- SEQ. NO., PAYT. TYPE, PAYT. BEGIN, PAYT. END
      4 DECIMAL CODES -- ANNUAL VALUE INCREASE %, ACRES, UNITS, VALUE
      EXAMPLE 1: 12,1,0,150,5.,1.0,1.0,-25.25
      EXAMPLE 2: 3,0,0,0,0.,0.,0.,0.

      EXAMPLE 2 SHOWS HOW TO ELIMINATE A PARTICULAR SEQUENCE NUMBER (E.G., 3)
      THAT EXISTS IN A BASE FROM THE ALTERNATIVE.

5,2,5,15,0 0,1.0,1.0,2.50

ENTER RECORD-TYPE IDENTIFIER: 6

ENTER OPTIONAL COMBINATION NUMBER (UP TO 2 DIGITS) FOLLOWED BY
ITEM DESCRIPTION (26 CHARACTERS MAXIMUM),(E.G., 16PLANTING COST):
2FISHING LEASE--BASE

ENTER 4 INTEGER CODES -- SEQ. NO., PAYT. TYPE, PAYT. BEGIN, PAYT. END
      4 DECIMAL CODES -- ANNUAL VALUE INCREASE %, ACRES, UNITS, VALUE
      EXAMPLE 1: 12,1,0,150,5.,1.0,1.0,-25.25
      EXAMPLE 2: 3,0,0,0,0.,0.,0.,0.

      EXAMPLE 2 SHOWS HOW TO ELIMINATE A PARTICULAR SEQUENCE NUMBER (E.G., 3)
      THAT EXISTS IN A BASE FROM THE ALTERNATIVE.

6,2,5,15,0.0,1.0,1.0,1.00

ENTER RECORD-TYPE IDENTIFIER: 6

ENTER OPTIONAL COMBINATION NUMBER (UP TO 2 DIGITS) FOLLOWED BY
ITEM DESCRIPTION (26 CHARACTERS MAXIMUM),(E.G., 16PLANTING COST):
2FISHING LEASE--INCREASE

ENTER 4 INTEGER CODES -- SEQ. NO., PAYT. TYPE, PAYT. BEGIN, PAYT. END
      4 DECIMAL CODES -- ANNUAL VALUE INCREASE %, ACRES, UNITS, VALUE
      EXAMPLE 1: 12,1,0,150,5.,1.0,1.0,-25.25
      EXAMPLE 2: 3,0,0,0,0.,0.,0.,0.

      EXAMPLE 2 SHOWS HOW TO ELIMINATE A PARTICULAR SEQUENCE NUMBER (E.G., 3)
      THAT EXISTS IN A BASE FROM THE ALTERNATIVE.

7,3,5,15,0 0,1.0,1.0,0.25

ENTER RECORD-TYPE IDENTIFIER: 6

ENTER OPTIONAL COMBINATION NUMBER (UP TO 2 DIGITS) FOLLOWED BY
ITEM DESCRIPTION (26 CHARACTERS MAXIMUM),(E.G., 16PLANTING COST):
3CAMPING SITE

ENTER 4 INTEGER CODES -- SEQ. NO., PAYT. TYPE, PAYT. BEGIN, PAYT. END
      4 DECIMAL CODES -- ANNUAL VALUE INCREASE %, ACRES, UNITS, VALUE
      EXAMPLE 1: 12,1,0,150,5.,1.0,1.0,-25.25
      EXAMPLE 2: 3,0,0,0,0.,0.,0.,0.

      EXAMPLE 2 SHOWS HOW TO ELIMINATE A PARTICULAR SEQUENCE NUMBER (E.G., 3)
      THAT EXISTS IN A BASE FROM THE ALTERNATIVE.
```

```
8,52,5,15,0.0,1.0,1.0,-33.25

ENTER RECORD-TYPE IDENTIFIER: 6

ENTER OPTIONAL COMBINATION NUMBER (UP TO 2 DIGITS) FOLLOWED BY
ITEM DESCRIPTION (26 CHARACTERS MAXIMUM),(E.G., 16PLANTING COST):
1INITIAL HARVEST

ENTER 4 INTEGER CODES -- SEQ. NO., PAYT. TYPE, PAYT. BEGIN, PAYT. END
      4 DECIMAL CODES -- ANNUAL VALUE INCREASE %, ACRES, UNITS, VALUE
      EXAMPLE 1: 12,1,0,150,5.,1.0,1.0,-25.25
      EXAMPLE 2: 3,0,0,0,0.,0.,0.,0.

      EXAMPLE 2 SHOWS HOW TO ELIMINATE A PARTICULAR SEQUENCE NUMBER (E.G., 3)
      THAT EXISTS IN A BASE FROM THE ALTERNATIVE.

9,1,0,0,2.0,0.0,1.0,50.00

ENTER RECORD-TYPE IDENTIFIER: 6

ENTER OPTIONAL COMBINATION NUMBER (UP TO 2 DIGITS) FOLLOWED BY
ITEM DESCRIPTION (26 CHARACTERS MAXIMUM),(E.G., 16PLANTING COST):
FINAL HARVEST--II

ENTER 4 INTEGER CODES -- SEQ. NO., PAYT. TYPE, PAYT. BEGIN, PAYT. END
      4 DECIMAL CODES -- ANNUAL VALUE INCREASE %, ACRES, UNITS, VALUE
      EXAMPLE 1: 12,1,0,150,5.,1.0,1.0,-25.25
      EXAMPLE 2: 3,0,0,0,0.,0.,0.,0.

      EXAMPLE 2 SHOWS HOW TO ELIMINATE A PARTICULAR SEQUENCE NUMBER (E.G., 3)
      THAT EXISTS IN A BASE FROM THE ALTERNATIVE.

10,1,30,30,2.0,1.0,1.0,250.00

ENTER RECORD-TYPE IDENTIFIES: END

LISTING OF CREATED DATA FILE FOLLOWS: CHECK FOR OBVIOUS ERRORS

1ST. JOE NATIONAL FOREST
2LONEPINE DISTRICT
3RANGER J. ARMSTRONG
B  0   1FORESTRY OPPORTUNITIES I
5TIMBER OUTPUT                .00  5.00 10.00  3.00
6  1  1INITIAL HARVEST          81   0   0  2.00      .00     1.00       100.00
6  2  1PLANTING COST            1   1   1  0.00     1.00     1.00      -175.00
6  3  1FINAL HARVEST I          1  50  50  2.00    50.00    60.00         1.00
7  1                                                                    -50.00
A  1   1FORESTRY OPPORTUNITIES II
5MULTIPLE OUTPUT              .00  5.00 10.00  3.00
6  1
6  3  1FINAL HARVEST--I         1  30  30  2.00     1.00     1.00      1500.00
6  4  1COMMERCIAL THIN          1  20  20  2.00     1.00     1.00       500.00
6  5  2HUNTING LEASE            2   5  15   .00     1.00     1.00         2.50
6  6  2FISHING LEASE--BASE      2   5  15   .00     1.00     1.00         1.00
6  7  2FISHING LEASE--INCREASE  3   5  15   .00     1.00     1.00          .25
6  8  3CAMPING SITE            52   5  15   .00     1.00     1.00       -33.25
6  9  1INITIAL HARVEST          1   0   0  2.00      .00     1.00        50.00
6 10   FINAL HARVEST--II        1  30  30  2.00     1.00     1.00       250.00



IS DATA FILE ERROR-FREE SO PROCESSING CAN CONTINUE, YES OR NO? YES

ENTER OUTPUT FILE NAME: INVEST.OUT


                          *** DATA BEING PROCESSED. ***
          TO VIEW OUTPUT, ENTER "TYPE INVEST.OUT".
          TO PRINT OUTPUT, ENTER "PRINT INVEST.OUT".
```

Appedix B: Fixed-Format Data Entry

```
C:\SUBDIR\INVEST

HAS A DATA INPUT FILE BEEN CREATED (YES OR NO)? YES

DATA INPUT FILE MODE:
    1 => FORMATTED
    2 => FREE-FORMATTED
ENTER MODE CODE: 1

ENTER EXISTING DATA INPUT FILE NAME: INVEST.FOR

NOTE: BENEFITS ARE ALWAYS ASSUMED TO OCCUR AT THE END OF THE YEAR
     DO YOU WANT COSTS TO OCCUR AT:
         1 => END OF YEAR
         2 => BEGINNING OF YEAR
ENTER COST-TIMING CODE: 1

ENTER OUTPUT FILE NAME: INVEST.OUT


                  *** DATA BEING PROCESSED. ***

TO VIEW OUTPUT, ENTER "TYPE INVEST.OUT".
TO PRINT OUTPUT, ENTER "PRINT INVEST.OUT".

================================================================================

PRINT INVEST.FOR

1ST. JOE NATIONAL FOREST
2LONEPINE DISTRICT
3RANGER J. ARMSTRONG
B  0   1FORESTRY OPPORTUNITIES I
5TIMBER OUTPUT                  .00  5.00 10.00  3.00
6  1  1INITIAL HARVEST           81   0   0  2.00      .00     1.00       100.00
6  2  1PLANTING COST              1   1   1  0.00     1.00     1.00      -175.00
6  3  1FINAL HARVEST I            1  50  50  2.00    50.00    60.00         1.00
7  1                                                                      -50.00
A  1   1FORESTRY OPPORTUNITIES II
5MULTIPLE OUTPUT                .00  5.00 10.00  3.00
6  1
6  3  1FINAL HARVEST--I           1  30  30  2.00     1.00     1.00      1500.00
6  4  1COMMERCIAL THIN            1  20  20  2.00     1.00     1.00       500.00
6  5  2HUNTING LEASE              2   5  15   .00     1.00     1.00         2.50
6  6  2FISHING LEASE--BASE        2   5  15   .00     1.00     1.00         1.00
6  7  2FISHING LEASE--INCREASE    3   5  15   .00     1.00     1.00          .25
6  8  3CAMPING SITE              52   5  15   .00     1.00     1.00       -33.25
6  9  1INITIAL HARVEST            1   0   0  2.00      .00     1.00        50.00
6 10   FINAL HARVEST--II          1  30  30  2.00     1.00     1.00       250.00
```

Appendix C: Free-Format Data Entry

```
C:\SUBDIR\INVEST

HAS A DATA INPUT FILE BEEN CREATED (YES OR NO)? YES

DATA INPUT FILE MODE:
    1 => FORMATTED
    2 => FREE-FORMATTED
ENTER MODE CODE: 2

ENTER EXISTING DATA INPUT FILE NAME: INVEST.FRE

ENTER NAME OF FORMATTED FILE TO BE CONSTRUCTED: INVEST.FOR

NOTE: BENEFITS ARE ALWAYS ASSUMED TO OCCUR AT THE END OF THE YEAR
     DO YOU WANT COSTS TO OCCUR AT:
         1 => END OF YEAR
         2 => BEGINNING OF YEAR
ENTER COST-TIMING CODE: 1

ENTER OUTPUT FILE NAME: INVEST.OUT


                    *** DATA BEING PROCESSED. ***

TO VIEW OUTPUT, ENTER "TYPE INVEST.OUT".
TO PRINT OUTPUT, ENTER "PRINT INVEST.OUT".

================================================================================

PRINT INVEST.FRE

1,ST. JOE NATIONAL FOREST
2,LONEPINE DISTRICT
3,RANGER J. ARMSTRONG
B,0,1,FORESTRY OPPORTUNITIES I
5,TIMBER OUTPUT,0.00,5.00,10.00,3.00
6,1,1INITIAL HARVEST,81,0,0,2.00,0.0,1.00,100.00
6,2,1PLANTING COST,1,1,1,0.00,1.00,1.00,-175.00
6,3,1FINAL HARVEST I,1,50,50,2.00,50.00,60.00,1.00
7,1,-50.00
A,1,1,FORESTRY OPPORTUNITIES II
5,MULTIPLE OUTPUT,0.00,5.00,10.00,3.00
6,1
6,3,1FINAL HARVEST--I,1,30,30,2.00,1.0,1.0,1500.00
6,4,1COMMERCIAL THIN,1,20,20,2.00,1.0,1.0,500.00
6,5,2HUNTING LEASE,2,5,15,0.00,1.0,1.0,2.50
6,6,2FISHING LEASE--BASE,2,5,15,0.00,1.0,1.0,1.00
6,7,2FISHING LEASE--INCREASE,3,5,15,0.00,1.0,1.0,0.25
6,8,3CAMPING SITE,52,5,15,0.00,1.0,1.0,-33.25
6,9,1INITIAL HARVEST,1,0,0,2.00,0.0,1.0,50.00
6,10,FINAL HARVEST--II,1,30,30,2.00,1.0,1.0,250.00
```

Appendix D: INVEST V Output

```
                    ----INVEST V----
                  A COMPUTER PROGRAM
                  TO EVALUATE FORESTRY
                INVESTMENT OPPORTUNITIES


FORESTRY ORGANIZATION:  ST. JOE NATIONAL FOREST                DATE: 03/11/94
ORGANIZATION SUBDIVISION: LONEPINE DISTRICT                    TIMING: COSTS: YEAR ENDING
ANALYST: RANGER J. ARMSTRONG                                           BENEFITS: YEAR ENDING
                                                               INPUT FILE: INVEST.FOR
                                                               OUTPUT FILE: INVEST.OUT


************************************************************
*PROJECT OR PROGRAM: FORESTRY OPPORTUNITIES I              *
*BASE PROBLEM OR ALTERNATIVE: TIMBER OUTPUT                *   OPT1 RATE      OPT2 RATE      RANKING RATE   INFLATN. RATE
************************************************************      0.00           5.00           10.00          3.00

                                                                  INCRD      BEGINNING YEAR
SEQ.                                  PAYMT      YEARS          VALUE      NONDISCOUNTED                  $ DISCOUNTED AT 10.00%
 NO.          ITEM                    TYPE    BEGIN   END       RATE       TOTAL VALUE                    COST          BENEFIT
----          ----                    ----    -----   ---       ----       ----- -----                    ----          -------

  1  INITIAL HARVEST                    81        0     0      2.00            100.00                       0.00          100.00
  2  PLANTING COST                       1        1     1      0.00           -175.00                    -163.86            0.00
  3  FINAL HARVEST I                     1       50    50      2.00           3000.00                       0.00          301.55
                                                                                                    ----------------  ----------------
                                                                                        TOTALS =         -163.86          401.55
```

```
+++++++++++++++++++++++++++++++++++++++++++++++++
+ EVALUATION OF: TIMBER OUTPUT                  +
+             INFLATION RATE:   3.00%           +
+          PLANNING PERIOD:   50 YEARS          +
+++++++++++++++++++++++++++++++++++++++++++++++++
```

	DISCOUNT RATES				
	OPT1	STD1	OPT2	STD2	RANK
CRITERIA	0.00%	4.00%	5.00%	7.00%	10.00%
BENEFIT-COST RATIO	196.94	29.32	18.56	7.73	2.45
PRESENT NET VALUE	35318.64	4907.76	3015.25	1133.26	237.68
ANNUAL EQUIVALENT VALUE OF PNV	706.37	228.46	165.17	82.12	23.97
LAND EXPECTATION VALUES --LEV1	INFINITY	INFINITY	INFINITY	1958.68	182.98
--LEV2	INFINITY	13257.87	5015.72	1307.77	157.74
PNV OF NON-ROTATION ITEMS	100.00	100.00	100.00	100.00	100.00
PNV OF NON-ROTATION ITEMS --PLUS DISCOUNTED LEV1	INFINITY	INFINITY	INFINITY	1930.54	266.35
--PLUS DISCOUNTED LEV2	INFINITY	12847.96	4876.88	1322.21	243.40

INTERNAL RATES OF RETURN:
IRR = 13.66%
IRR1 = 11.45%
IRR2 = 11.37%

NOTES: - PNV AND IRR ARE BASED ON ONE PLANNING PERIOD, INCLUDING INFLATION AND VALUE INCREASES.

- LEV1 AND IRR1 ARE BASED ON PERPETUAL SERIES OF PLANNING PERIODS, INFLATION AND VALUE INCREASES CONTINUING BEYOND FIRST PLANNING PERIOD.

- LEV2 AND IRR2 ARE BASED ON PERPETUAL SERIES OF PLANNING PERIODS, INFLATION AND VALUE INCREASES STOPPING AFTER FIRST PLANNING PERIOD.

- ANNUAL EQUIVALENT VALUE OF PNV IS BASED ON ONE PLANNING PERIOD, INCLUDING VALUE INCREASES.

- LEV1 AND LEV2 CORRESPOND TO 49 YEAR ROTATIONS BEGINNING IN YEAR 1.

```
+++++++++++++++++++++++++++++++++++++++++++++++
+      COMBINATIONS FEATURE REPORT            +
+        LISTING OF COMBINED ITEMS            +
+          DISCOUNTED AT  10.00%              +
+ FOR PROBLEM: TIMBER OUTPUT                  +
+++++++++++++++++++++++++++++++++++++++++++++++
```

SEQ. NO.	COMBINATION NO.	DESCRIPTION	COST	BENEFIT
	1		-163.86	401.55
		TOTALS =	-163.86	401.55

```
+++++++++++++++++++++++++++++++++++++++++++++
+        SENSITIVITY ANALYSIS REPORT        +
+ FOR PROBLEM: TIMBER OUTPUT                +
+++++++++++++++++++++++++++++++++++++++++++++
```

SEQ. NO.	ACRE, UNIT OR VALUE CHANGE	$ CHANGE IN DISCOUNTED VALUE COST	BENEFIT	BENEFIT-COST RATIO 10.00%	PRESENT NET VALUE AT 10.00%	IRR
1	-50.00%	0.00	-50.00	2.15	187.68	12.22%
SENSITIZED PROJECT TOTALS:		0.00	-50.00	2.15	187.68	12.22%

```
************************************************************
*PROJECT OR PROGRAM: FORESTRY OPPORTUNITIES II             *
*BASE PROBLEM OR ALTERNATIVE: MULTIPLE OUTPUT              *
************************************************************
```

OPT1 RATE	OPT2 RATE	RANKING RATE	INFLATN. RATE
0.00	5.00	10.00	3.00

SEQ. NO.	ITEM	PAYMT TYPE	YEARS BEGIN	YEARS END	INCRD VALUE RATE	BEGINNING YEAR NONDISCOUNTED TOTAL VALUE	$ DISCOUNTED AT 10.00% COST	BENEFIT
2	PLANTING COST	1	1	1	0.00	-175.00	-163.86	0.00
3	FINAL HARVEST--I	1	30	30	2.00	1500.00	0.00	377.95
4	COMMERCIAL THIN	1	20	20	2.00	500.00	0.00	199.46
5	HUNTING LEASE	2	5	15	0.00	2.50	0.00	14.56
6	FISHING LEASE--BASE	2	5	15	0.00	1.00	0.00	5.82
7	FISHING LEASE--INCREASE	3	5	15	0.00	0.25	0.00	6.33
8	CAMPING SITE	52	5	15	0.00	-33.25	-193.63	0.00
9	INITIAL HARVEST	1	0	0	2.00	50.00	0.00	50.00
10	FINAL HARVEST--II	1	30	30	2.00	250.00	0.00	62.99
						TOTALS =	-357.50	717.12

```
+++++++++++++++++++++++++++++++++++++++++++++++
+ EVALUATION OF: MULTIPLE OUTPUT               +
+              INFLATION RATE:   3.00%         +
+           PLANNING PERIOD:   30 YEARS        +
+++++++++++++++++++++++++++++++++++++++++++++++
```

	DISCOUNT RATES				
	OPT1	STD1	OPT2	STD2	RANK
CRITERIA	0.00%	4.00%	5.00%	7.00%	10.00%
BENEFIT-COST RATIO	13.59	6.10	5.02	3.43	2.01
PRESENT NET VALUE	8483.70	2576.35	1904.76	1022.61	359.62
ANNUAL EQUIVALENT VALUE OF PNV	282.79	148.99	123.91	82.41	38.15
LAND EXPECTATION VALUES --LEV1	INFINITY	INFINITY	INFINITY	2766.90	538.73
--LEV2	INFINITY	10238.66	4344.93	1501.33	417.73

INTERNAL RATES OF RETURN:
IRR = 14.46%
IRR1 = 14.69%
IRR2 = 14.46%

NOTES: - PNV AND IRR ARE BASED ON ONE PLANNING PERIOD, INCLUDING INFLATION AND VALUE INCREASES.

- LEV1 AND IRR1 ARE BASED ON PERPETUAL SERIES OF PLANNING PERIODS, INFLATION AND VALUE INCREASES CONTINUING BEYOND FIRST PLANNING PERIOD.

- LEV2 AND IRR2 ARE BASED ON PERPETUAL SERIES OF PLANNING PERIODS, INFLATION AND VALUE INCREASES STOPPING AFTER FIRST PLANNING PERIOD.

- ANNUAL EQUIVALENT VALUE OF PNV IS BASED ON ONE PLANNING PERIOD, INCLUDING VALUE INCREASES.

- LEV1 AND LEV2 CORRESPOND TO 30 YEAR ROTATIONS BEGINNING IN YEAR 0.

```
+++++++++++++++++++++++++++++++++++++++++++++++
+          OPPORTUNITY COST REPORT            +
+ FOR PROBLEM: MULTIPLE OUTPUT                +
+++++++++++++++++++++++++++++++++++++++++++++++
```

SEQ. NO.	ITEM	BEGINNING YEAR NONDISCOUNTED TOTAL VALUE	$ DISCOUNTED AT 10.00% COST OR BENEFIT
8	CAMPING SITE	-33.25	-193.63

CHANGE IN PROJECT PNV: 193.63 (WITHOUT OPPORTUNITY COSTS)

INTERNAL RATE OF RETURN: IRR = 18.67% (WITHOUT OPPORTUNITY COSTS)

```
+++++++++++++++++++++++++++++++++++++++++++++++
+      COMBINATIONS FEATURE REPORT            +
+        LISTING OF COMBINED ITEMS            +
+          DISCOUNTED AT  10.00%              +
+ FOR PROBLEM: MULTIPLE OUTPUT                +
+++++++++++++++++++++++++++++++++++++++++++++++
```

SEQ. NO.	COMBINATION NO.	DESCRIPTION	COST	BENEFIT
	1		-163.86	627.41
	2		0.00	26.71
	3		-193.63	0.00
10		FINAL HARVEST--II	0.00	62.99
		TOTALS =	-357.50	717.12

```
+++++++++++++++++++++++++++++++++++++++++++++++
+          A AND B COMPARISONS                +
+    BASED ON RESPECTIVE RANKING RATES        +
+ FOR PROBLEM: MULTIPLE OUTPUT                 +
+++++++++++++++++++++++++++++++++++++++++++++++
```

NOTE: WHEN EITHER THE ABSOLUTE VALUE OF A COST OR BENEFIT ITEM FOR THE ALTERNATIVE IS GREATER THAN THAT OF THE BASE, THE DIFFERENCE WILL BE POSITIVE. LIKEWISE WHEN THE ABSOLUTE VALUE IS LESS THAN THAT OF THE BASE, THE DIFFERENCE WILL BE NEGATIVE(-)

ALTERNATIVE: MULTIPLE OUTPUT — DISCOUNTED AT 10.00%
VERSUS BASE: TIMBER OUTPUT — DISCOUNTED AT 10.00%

SEQ. NO.	ITEM	ABS($ALT)-ABS($BASE) COST	BENEFIT
1	INITIAL HARVEST		-100.00
3	FINAL HARVEST I		76.40
4	COMMERCIAL THIN		199.46
5	HUNTING LEASE		14.56
6	FISHING LEASE--BASE		5.82
7	FISHING LEASE--INCREASE		6.33
8	CAMPING SITE	193.63	
9	INITIAL HARVEST		50.00
10	FINAL HARVEST--II		62.99
		---	---
DISCOUNTED NET CHANGE FROM BASE =		193.63	315.57
	CHANGE IN PNV:	121.94	

```
++++++++++++++++++++++++++++++++++++++
+   ORDERING OF PROJECTS OR PROGRAMS +
+  BASED ON RESPECTIVE RANKING RATES +
++++++++++++++++++++++++++++++++++++++
```

PROBLEM TITLE	RANKING RATE	PLANNING PERIOD	ROTATION PERIOD	YEAR ZERO OF ROTATION #1
TIMBER OUTPUT	10.00%	50	49	1
MULTIPLE OUTPUT	10.00%	30	30	0

PROJECTS RANKED BY PRESENT NET VALUE

PROBLEM TITLE	PNV
MULTIPLE OUTPUT	359.62
TIMBER OUTPUT	237.68

PROJECTS RANKED BY BENEFIT-COST RATIO

PROBLEM TITLE	B/C
TIMBER OUTPUT	2.45
MULTIPLE OUTPUT	2.01

PROJECTS RANKED BY ANNUAL EQUIVALENT VALUE

PROBLEM TITLE	AEV
MULTIPLE OUTPUT	38.15
TIMBER OUTPUT	23.97

PROJECTS RANKED BY INTERNAL RATE OF RETURN

PROBLEM TITLE	IRR
MULTIPLE OUTPUT	14.46
TIMBER OUTPUT	13.66

PROJECTS RANKED BY INTERNAL RATE OF RETURN

PROBLEM TITLE	IRR1
MULTIPLE OUTPUT	14.69
TIMBER OUTPUT	11.45

PROJECTS RANKED BY INTERNAL RATE OF RETURN

PROBLEM TITLE	IRR2
MULTIPLE OUTPUT	14.46
TIMBER OUTPUT	11.37

PROJECTS RANKED BY LAND EXPECTATION VALUE

PROBLEM TITLE	LEV1
MULTIPLE OUTPUT	538.73
TIMBER OUTPUT	182.98

PROJECTS RANKED BY LAND EXPECTATION VALUE

PROBLEM TITLE	LEV2
MULTIPLE OUTPUT	417.73
TIMBER OUTPUT	157.74

PROJECTS RANKED BY PNV NON-ROTATION ITEMS PLUS DISCOUNTED LAND EXPECTATION VALUE 1

PROBLEM TITLE	
MULTIPLE OUTPUT	538.73
TIMBER OUTPUT	266.35

PROJECTS RANKED BY PNV NON-ROTATION ITEMS PLUS DISCOUNTED LAND EXPECTATION VALUE 2

PROBLEM TITLE	
MULTIPLE OUTPUT	417.73
TIMBER OUTPUT	243.40

```
++++++++++++++++++++++++++++++++++++++
+     MARGINAL ANALYSIS SUMMARY      +
+ BASED ON RESPECTIVE RANKING RATES +
++++++++++++++++++++++++++++++++++++++
```

PROBLEM TITLE	RANKING RATE	$ DISCOUNTED COST	$ DISCOUNTED BENEFIT	MARGINAL CHANGES COST	MARGINAL CHANGES BENEFIT	MARGINAL B/C RATIO
TIMBER OUTPUT	10.00%	163.86	401.55			
MULTIPLE OUTPUT	10.00%	357.50	717.12	193.63	315.57	1.63

Appendix E: INVEST V Coding Form

*U.S. GOVERNMENT PRINTING OFFICE 1994-0-573-029/01005

Schuster, Ervin G.; Zuuring, Hans R. 1994. User's guide to INVEST V: A computer program for economic analysis of forestry investment opportunities. Gen. Tech. Rep. INT-GTR-312. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 37 p.

INVEST V is a computer program to help evaluate forestry projects and programs as alternative investment opportunities. It operates on the Forest Service's Data General computer system and any IBM-compatible microcomputer. The guide presents an overview of INVEST V, describes data organization and program features, and includes examples of data input and output.

Keywords: economic analysis, efficiency, investment planning

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